Photo-identification Catalogue and Status of the Northern Resident Killer Whale Population in 2014.

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ABSTRACT

Towers, J.R., Ellis, G.M. and Ford, J.K.B. 2015. Photo-identification catalogue and status of the northern resident killer whale population in 2014. Can. Tech. Rep. Fish. Aquat. Sci. 3139: iv + 75 p.

Field studies of the life history and ecology of killer whale populations off Canada's west coast have been conducted annually since 1973. These studies are based on the identification of individual whales from photographs of permanent, natural markings. In this report, we summarize abundance trends in the northern resident killer whale population between 1974 and 2014, and provide an updated photo-identification catalogue of individuals. In 2014, the northern resident population was composed of 290 whales. The population has grown at an average mean annual rate of 2.2% since 1974. Continued population monitoring by photo-identification is a key research activity in the recovery strategy for this threatened population.

RÉSUMÉ

Towers, J. R., Ellis, G. M. et Ford, J. K. B. 2015. Catalogue de photographies d'identification et état de la population d'épaulards résidents du nord en 2014. Rapp. tech. can. sci. halieut. aquat. 3139: iv + 75 p.

Depuis 1973, des études sur le terrain sont menées chaque année afin d'observer le cycle de vie et les caractéristiques écologiques des populations d'épaulards qui vivent le long de la côte ouest du Canada. Ces études reposent sur l'identification d'individus à partir de photographies de leurs marques naturelles permanentes. Dans le présent rapport, nous présentons la courbe évolutive de la population d'épaulards résidents du nord de 1974 à 2014, ainsi qu'une mise à jour du catalogue de photographies d'identification des individus qui forment cette population. En 2014, la population d'épaulards résidents du nord était composée de 290 individus. Depuis 1974, la croissance de la population a suivi un taux annuel moyen de 2,2 %. La surveillance continue à partir de photographies d'identification est une activité de recherche essentielle à la stratégie de rétablissement de cette population menacée.

1.0 INTRODUCTION

Killer whales off the west coast of Canada were among the first cetaceans found to be individually recognizable from photographs of natural markings (Bigg et al. 1976). The use of photo-identification to study killer whale populations in British Columbia began in 1973 and continues to the present (Ford 2011). Data collected using this method have been fundamental to the description of killer whale populations in the region and assessments of their abundance, life history traits and social organization (Bigg 1982; Bigg et al. 1990; Olesiuk et al. 1990, 2005; Ford and Ellis 1999; Ford et al. 1994, 2000, 2007, 2013, 2014; Williams and Lusseau 2006; Ellis et al. 2007, 2008, 2011; Foster et al. 2012; Towers et al. 2012a). The photo-identification technique has also facilitated a wide range of studies on the behaviour (e.g., Jacobsen 1986; Morton 1990; Baird and Dill 1995), acoustics (Ford and Fisher 1983; Ford 1991; Barrett-Lennard et al. 1996; Deecke et al. 2010), foraging ecology (Nichol and Shackleton 1996; Ford et al. 1998, 2005, 2010a,b; Ford and Ellis 2006) and genetics (Barrett-Lennard 2000) of killer whale populations in British Columbia.

Three separate ecotypes of killer whales have been found to share coastal waters off the west coast of Canada – residents, Bigg's (transients) and offshores. These ecotypes do not mix despite living in the same habitats, and as a result they are reproductively isolated and genetically distinct (Ford et al. 2000; Krahn et al. 2007a; Ford 2014). Each ecotype specializes on different prey resources. Resident killer whales feed on fish, with a strong preference for salmon, especially Chinook (Ford and Ellis 2006; Ford et al. 2010b). Bigg's killer whales prey on marine mammals (Ford et al. 1998) and offshore killer whales feed on sharks and other large fish species (Ford et al. 2011, 2014).

Resident killer whales in British Columbia are represented by two distinct populations, northern and southern, which have overlapping ranges but do not intermingle. The northern resident population, which is the subject of this report, ranges between southern Washington and southeastern Alaska (Dahlheim et al. 1997; Ford et al. 2000; Ellis et al. 2011). Within this overall range, the majority of encounters with northern resident killer whales have taken place in the coastal waters of British Columbia (Ford 2006; Ellis et al. 2011). The smaller southern resident killer whale population ranges from central California to southeastern Alaska (Ford 2012), but is found most frequently during summer and fall in the transboundary waters of the Salish Sea, between northern Washington and southern Vancouver Island (Ford et al. 1994).

Resident killer whales travel in family groups that remain cohesive over long periods of time (Bigg et al. 1987). These social groups, referred to as pods (Bigg et al. 1976), subpods (Bigg et al. 1987) or matrilines (Ford et al. 2000) are typically composed of one or more maternally-related reproductive females and their offspring. Maternally-related individuals that have descended from a common ancestor share a common

acoustic dialect and are thus referred to as belonging to the same clan (Ford 1991). Different clans have no calls in common and sound distinct. The northern resident population is composed of 3 clans – A, G and R. Southern resident killer whales all belong to J clan (Bigg et al. 1987).

Killer whales from both the northern and southern resident populations were exploited in British Columbia and Washington by a live-capture fishery that began in 1964 to supply demand for killer whales in aquariums. At least fifty individuals were removed from the northern and southern resident populations in the following decade (Bigg and Wolman, 1975; Bigg et al. 1976; Ford et al. 1994). Many other individuals were caught and released, sometimes on more than one occasion. Removals by this fishery and mortalities likely due to intentional shootings resulted in depleted resident killer whale populations by the early 1970s. Preliminary results of photo-identification studies by Bigg et al. (1976) showed that resident killer whale population sizes were too small to sustain this fishery. Combined with public opposition to the captures, this led to the end of the fishery in 1976 (Ford 2011).

Annual censuses of resident killer whales in both British Columbia and Washington have been undertaken each year since 1974, coordinated by researchers with the Pacific Biological Station, Nanaimo, BC (primarily northern residents) and the Center for Whale Research, Friday Harbor, WA (southern residents). Both resident populations showed a long-term positive growth trend between 1974 and the mid 1990s, increasing at average rates of 2.5 to 3% per annum (Bigg 1982; Olesiuk et al. 1990, 2005). Northern and southern resident populations both experienced sharp increases in mortality rates and a decline in abundance during the latter half of the 1990s and early 2000s, which coincided with a coast-wide decline in availability of their primary prey, Chinook salmon (Ford et al. 2005, 2010a). In 2001, the conservation status of killer whales off the west coast was assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The northern residents were designated as threatened and southern residents as endangered due to their small population sizes, low reproductive rate and the existence of a variety of anthropogenic threats (Ford 2006; COSEWIC 2008; Fisheries and Oceans Canada 2011). These populations were subsequently legally listed as such under Canada's Species at Risk Act (SARA), and the process of recovery strategy development and identification of critical habitat was initiated (Fisheries and Oceans Canada 2011). Effort to annually census resident killer whales by photo-identification is recognized in the resident killer whale recovery strategy as an integral component of on-going population monitoring in Canada.

Results of the annual photo-identification censuses of resident killer whales have been presented in various scientific reports as well as catalogues intended for use by managers, field researchers, the whale-watch community and the interested public. Technical reports describing the population status and dynamics of resident killer whales include Bigg et al. (1976, 1990), Bigg (1982), Balcomb et al. (1980, 1982), Olesiuk et al. (1990, 2005), Ford et al. (2005, 2010b), and Ellis et al. (2011). Photo-

identification catalogues for northern and southern resident populations were provided in Bigg et al. (1987), and Ford et al. (1994, 2000). Updated catalogues of southern and northern residents have been periodically provided by the Center for Whale Research (whaleresearch.com) and the Cetacean Research Program at the Pacific Biological Station respectively (Ellis et al. 2007; 2011).

In this report, we present a summary of the current population status of the northern resident killer whale population through 2014, and an updated photo-identification catalogue of individuals. This catalogue includes demographic and genealogical data for all whales in the northern resident population. These data were gathered from annual photo-identification population censuses and associated long-term visual monitoring. This catalogue is intended to provide colleagues with a tool to facilitate their work. Furthermore, it is hoped that it will enrich observations of this population by marine wildlife viewers off the west coasts of Canada and the US.

2.0 MATERIALS AND METHODS

2.1 DATA COLLECTION AND ANALYSIS

Methods for the collection of identification photos of killer whales were first described in Bigg et al. (1976, 1986). Details outlining the use of updated field methods and equipment are described in Ellis et al. (2011). Photo-identification data analysis and management techniques are provided in Towers et al. (2012b).

2.2 DATA PRESENTATION

The appendix includes identification photographs of whales known or presumed to be alive at the end of the 2014 field season. In most cases, individuals laid out in clusters represent socially cohesive groups. However, some maternally-related individuals (primarily adult females with their own offspring, orphans and mature bulls without living mothers) may or may not exhibit social cohesion with others in their matriline (Ford and Ellis 2002; Ford 2006; DFO unpubl. data). Matrilines are typically named after the eldest living reproductive female within a group of maternally-related individuals, although if she has a surviving brother or uncle, the matriline is named after the deceased mother of the eldest male. Pod names are also provided and refer to the most distinctive whale documented in each social group when they were first identified in the early 1970s. Tabs are provided on the outside edge of each page to show the acoustic clan to which each group belongs (see introduction).

The appendix also includes schematic diagrams of the different northern resident killer whale lineages. The structure of each lineage is portrayed to represent matrilineal-based genealogical relationships that have been inferred from long-term observations of social organization (Bigg et al. 1987, 1990; Ford et al. 1994, 2000; Ford and Ellis 2002; Ellis et al. 2011). Diagrams include every individual documented over the course of the

study. Clear boxes represent individuals known or presumed to be alive in 2014 and shaded boxes represent deceased individuals (see key on page 15). Lines linking mothers and offspring are solid if the relationship is positive (i.e., known with certainty). This includes individuals that have been documented since birth. Relationships of whales born before the study began in the early 1970s are either probable, indicated by a dashed line, or possible, indicated by a dotted line.

3.0 RESULTS AND DISCUSSION

Photo-identification censuses of the northern resident killer whale population have been conducted annually since 1974. The last population update and associated photo-identification catalogue was based on the 2010 field season and published in Ellis et al. (2011). During 2011–2014, we travelled up to 10,000 km per year in search of northern residents and averaged 58 encounters per year (range: 52-67) with this population. This is roughly consistent with the effort and number of encounters with northern residents during previous years (Bigg 1982; Ellis et al. 2011). Between 2011 and 2014 we analyzed a total of 28,012 identification images of whales in this population.

Although the majority of whales were photographed each year, it was not always possible to locate every animal during each field season. As a result, there was occasionally some uncertainty in the number of animals alive each year. For example, 33 individuals from the northern resident population could not be accounted for in 2014. The status of these individuals was confirmed when 28 of them were photo-identified in 2015 and five were not. Three other animals that disappeared from their matrilines part way through 2014 are included in the population count but identification images of them have been excluded from the appendix because they are now confirmed to be dead. In total, the northern resident killer whale population numbered 290 individuals in 2014.

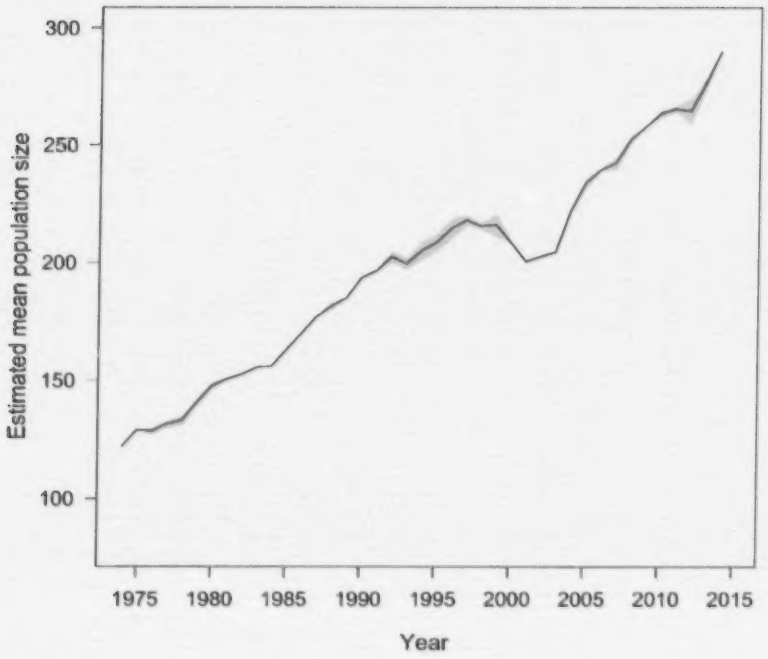

Figure 1. Abundance trend of the northern resident killer whale population, 1974–2014. In years with uncertainty, the minimum and maximum population sizes are represented with shading.

The abundance trend of the northern resident population during 1974–2014 is shown in Figure 1. From the mid 1970s to mid 1990s, the population grew steadily at an average mean annual rate of 2.6%, from approximately 122 individuals in 1974 to 218 in 1997. The population then declined by about 7% during 1998–2001, a period that coincided with a significant reduction in the availability of the whales' primary prey, Chinook salmon (Ford et al. 2010b). Starting in 2002, the growth trend became positive once again, with the population increasing at an average mean rate of 2.9% per year until 2014 (range = -0.4 – 8.6% per annum). This represents an average annual mean increase of 2.2% over the 40 year time series. All three northern resident clans experienced growth during 1974–2014, but at different rates (Figure 2). The G clan grew at the greatest average mean rate of 2.9% per annum followed by R clan at 2.1% per annum, and A clan at 1.9% per annum. By contrast, the southern resident population (J clan) has not maintained similar growth over the same time period (Bigg et al. 1976; Ellis et al. 2011; Cogan 2014).

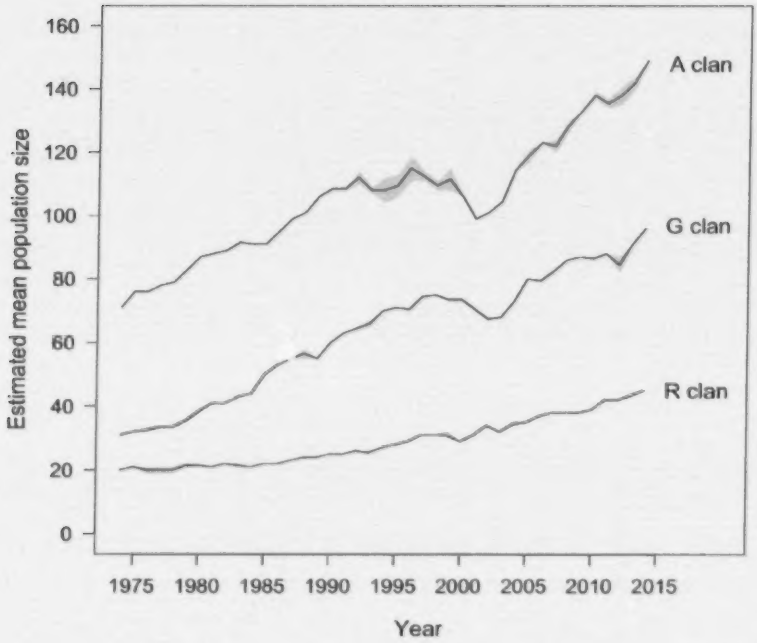

Figure 2. Abundance trends of A, G and R clans, 1974–2014. In years with uncertainty, the minimum and maximum population sizes are represented with shading.

Several factors may influence population trends for resident killer whales. Among these, prey availability (Ford et al. 2005, 2010a,b; Ayres et al. 2012), disturbance (Erbe 2002; Morton and Symonds 2002; Williams et al. 2002a,b; Williams and Ashe 2007; Lusseau et al. 2009) and pollution (Ross et al. 2000; Rayne et al. 2004; Ross 2006; Krahn et al. 2007b; 2009; Lachmuth et al. 2010, 2011; Williams et al. 2014) are of primary conservation concern (Fisheries and Oceans Canada 2011). Several other threats such as vessel strikes (Williams and O'Hara 2009), entanglement (Bigg and Wolman 1975; Fisheries and Oceans Canada 2011) and intentional shootings also have the potential to directly affect mortality rates of the northern and southern resident killer whale populations.

With each year of field research, our understanding of the distribution, demographics, behaviour and population trends of northern resident killer whales improves, as does our ability to detect subtle changes in population parameters that may result from anthropogenic threats. On-going photo-identification monitoring will continue to be a key component of recovery efforts focused on the northern resident population and other communities of killer whales that live off the west coast of North America.

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APPENDIX

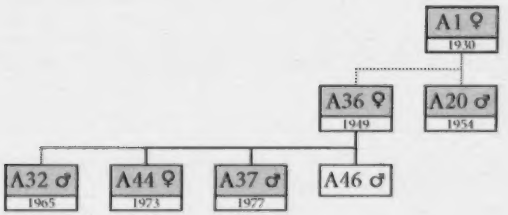
PHOTO-IDENTIFICATION CATALOGUE OF NORTHERN RESIDENT KILLER WHALES

A1 Pod,
A36 Matriline

A46 ♂ 1982

CATALOGUE KEY

- A1 ♀ 1930 — Name, sex, and birth year of deceased whale
- A46 ♂ — Name and sex of live whale
- ——— Positive Relationship
- ——— Probable Relationship
- ..... Possible Relationship



A1 Pod,
A30 Matriline

A38 ♂ 1971

A50 ♀ 1984

A54 ♀ 1989

A72 ♀ 1999

A84 2005

A99 2011

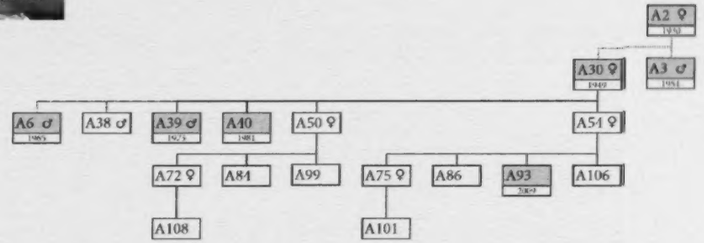
A75 ♀ 2002

A86 2006

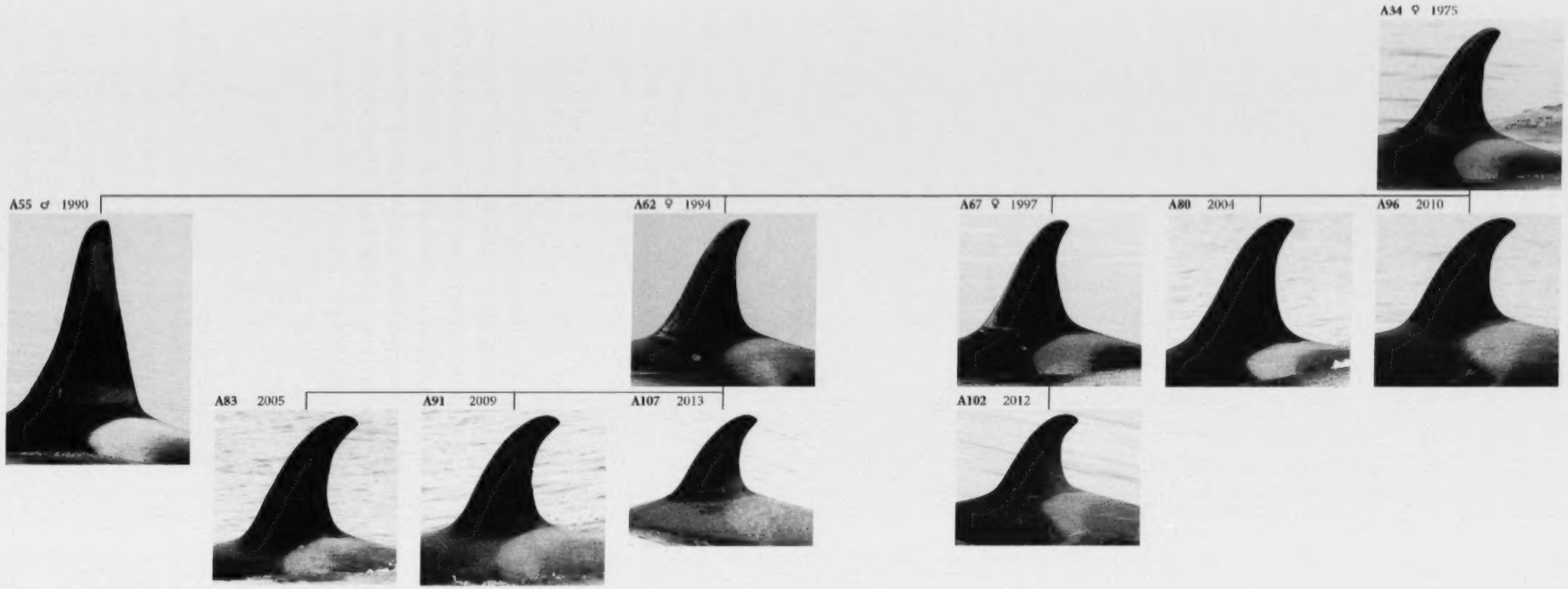
A106 2013

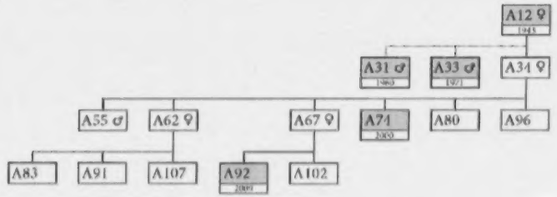
A108 2014

A101 2012

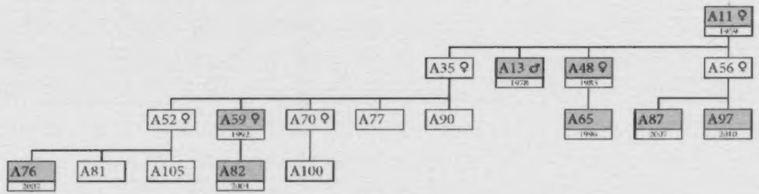


A1 Pod,
A34 Matriline





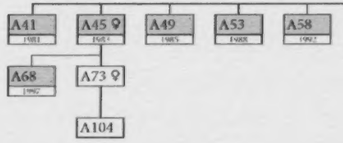
A4 Pod,
A35 Matriline



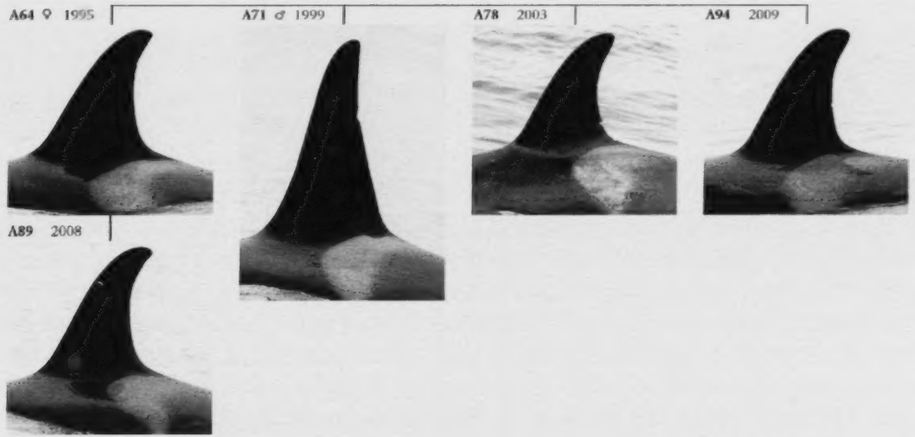
A4 Pod,
A56 Matriline

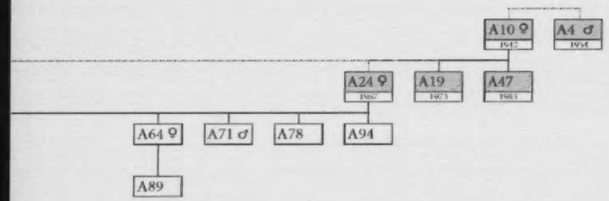
A4 Pod,
A24 Matriline

A73 and her offspring normally travel with the A35 and A56 matrilines.

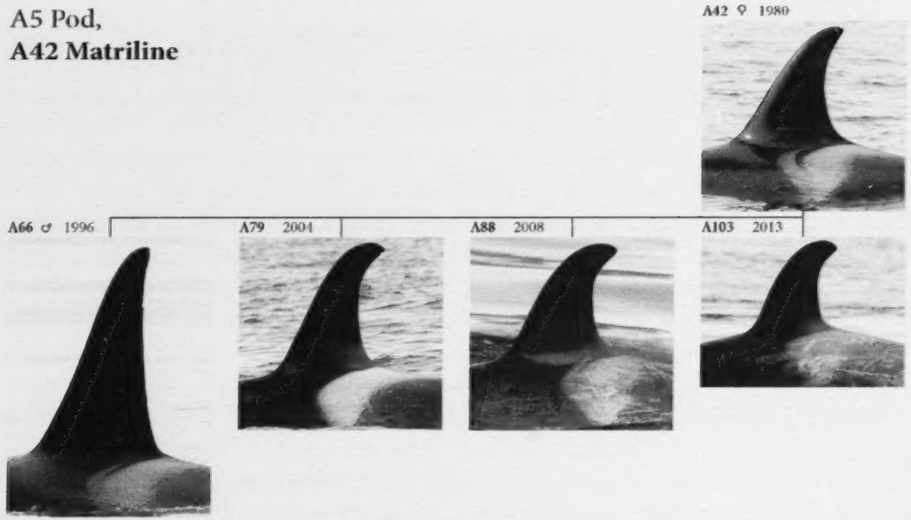


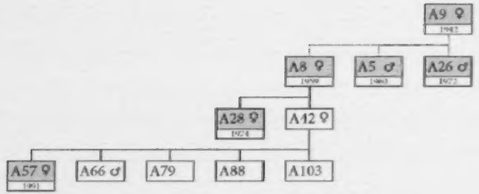
A4 Pod,
A24 Matriline
continued



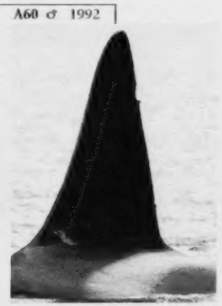


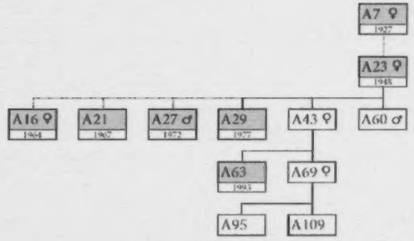
A5 Pod,
A42 Matriline



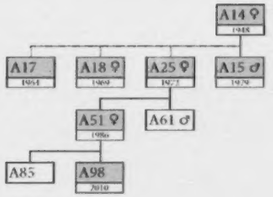


A5 Pod,
A23 Matriline

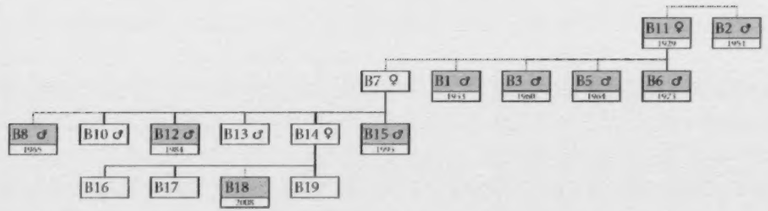




A5 Pod,
A25 Matriline



B1 Pod,
B7 Matriline



B7 ♀ 1949

B10 ♂ 1979

B13 ♂ 1987

B14 ♀ 1991

B16 2004

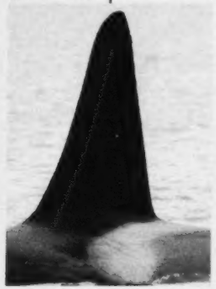
B17 2008

B19 2014

C1 Pod,
C6 Matriline

C8 ♀ 1975

C16 ♂ 1989



C31 2009

C27 2006

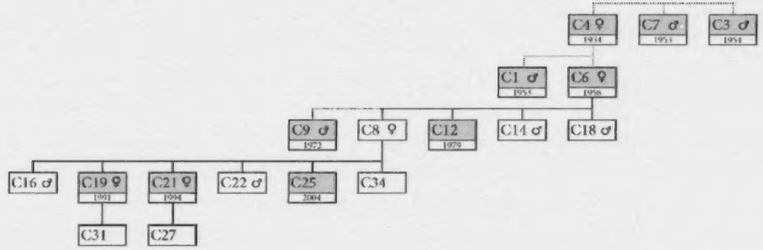
C22 ♂ 1997

C34 2013

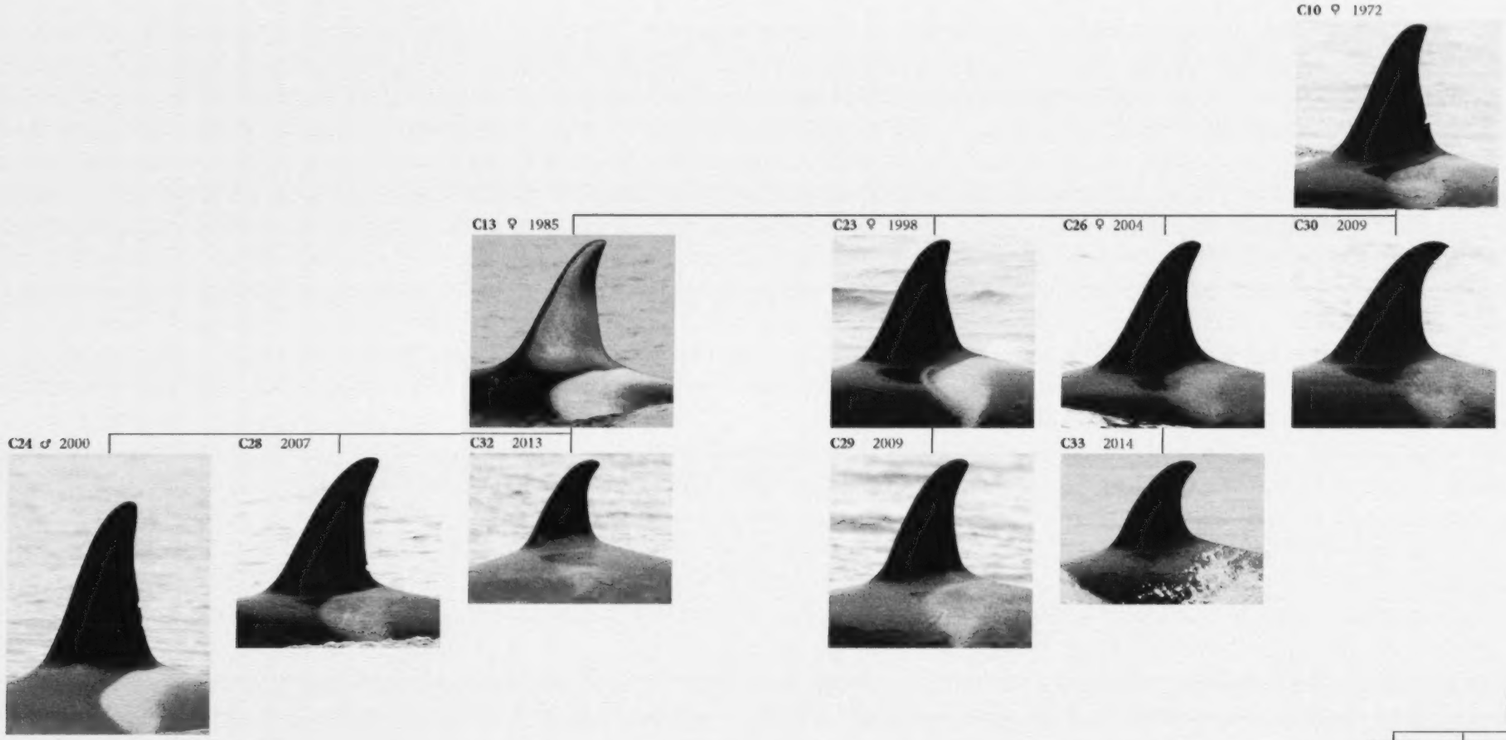
C8, her offspring, and C27 are not always documented with C14 and C18.

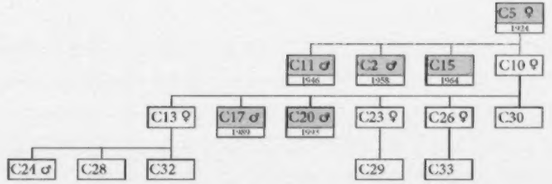
C14 ♂ 1985

C18 ♂ 1991



C1 Pod,
C10 Matriline





A-Clan

D1 Pod, **D12 Matriline**

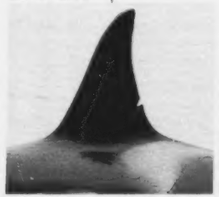
D12 ♀ 1982

D20 ♀ 1999

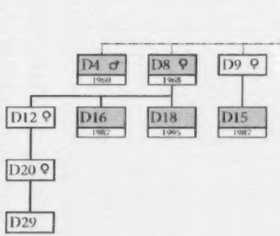
D29 2014

D1 Pod, **D9 Matriline**

D9 ♀ 1972



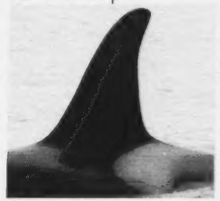
Since the death of C19, C31 has been travelling with D9.



D1 Pod, **D13 Matriline**

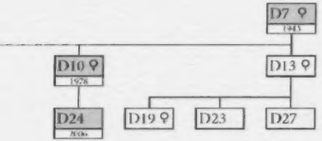
D13 ♀ 1984

D19 ♀ 1998



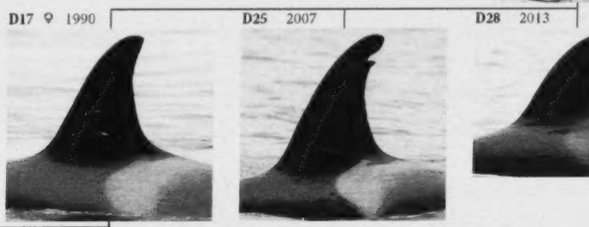
D23 2005

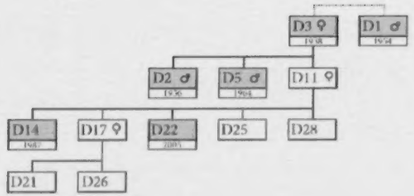
D27 2012



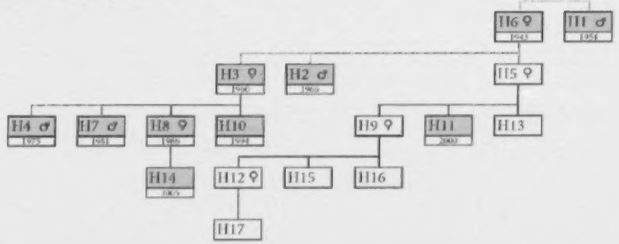
D1 Pod,
D11 Matriline

The four matrilines in D pod are usually found together.





H1 Pod,
H5 Matriline



I1 Pod,
I19 Matriline

I54 ♀ 1983

I92 ♀ 1999

I117 2005

I132 2010

I71 ♀ 1993

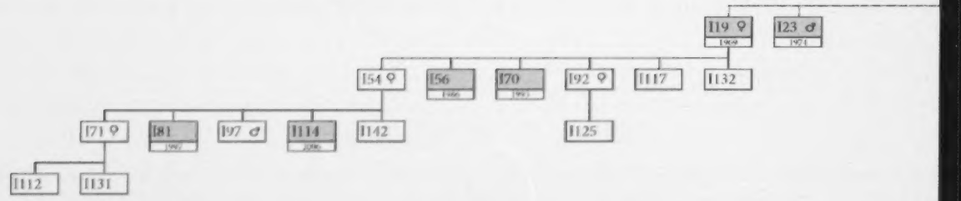
I97 ♂ 2002

I142 2013

I125 2008

I112 2006

I131 2010



A-Clan

I1 Pod,
I40 Matriline

I40 ♀ 1980

I69 ♀ 1991

I90 ♀ 1999

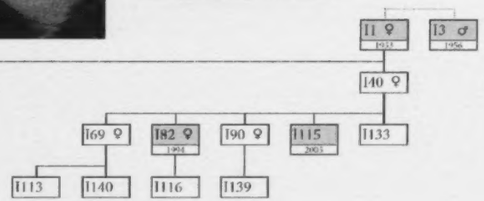
I133 2010

I113 2006

I140 2013

I116 2006

I139 2012



I18 Pod,
I17 Matriline

A-Clan

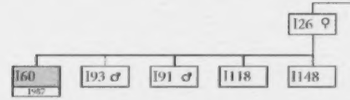
I26 ♀ 1975

I93 ♂ 1992

I91 ♂ 1996

I118 2006

I148 2014



I18 Pod,
I17 Matriline
continued

I50 and her offspring are not always found with the rest of the I17 matriline.

I17 ♀ 1960

I50 ♀ 1983

I57 ♀ 1989

I99 ♀ 2003

I89 ♂ 1996

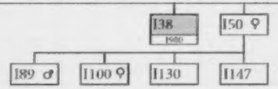
I100 ♀ 2003

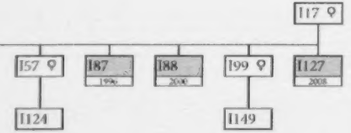
I130 2010

I147 2014

I124 2007

I149 2014

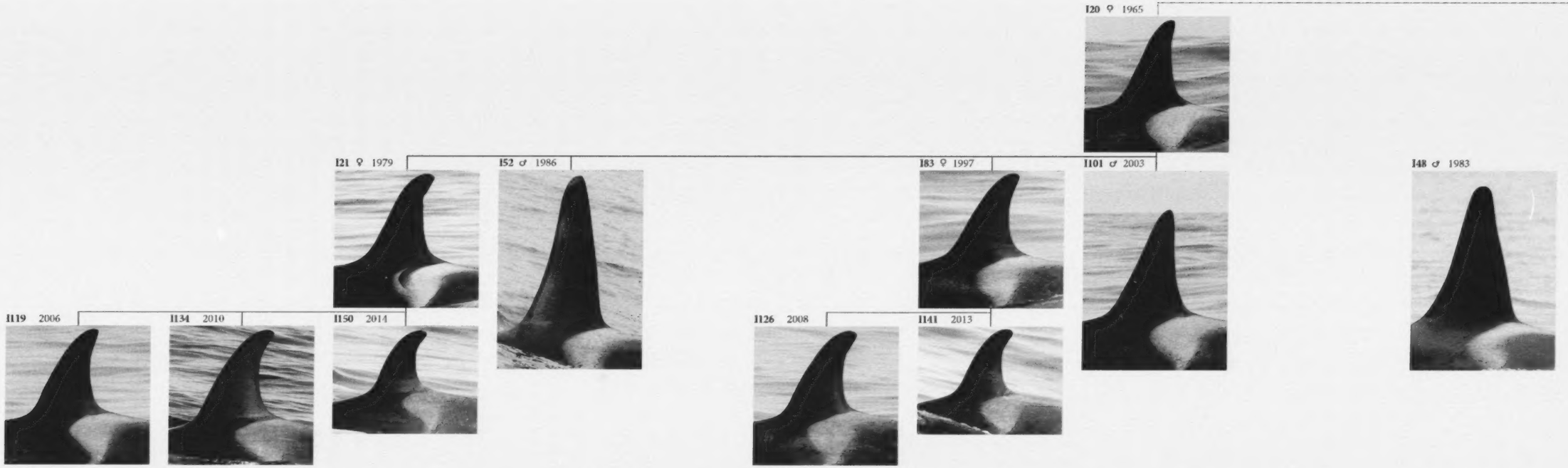


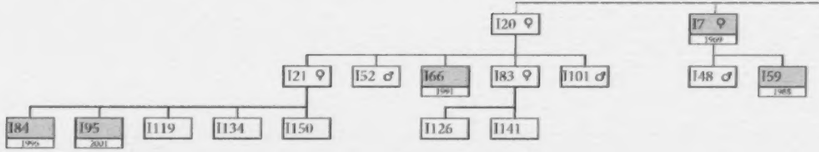


A-Clan

I18 Pod,
I18 Matriline

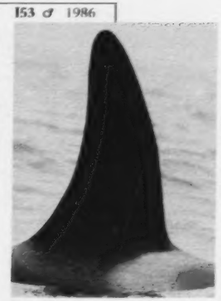
A-Clan



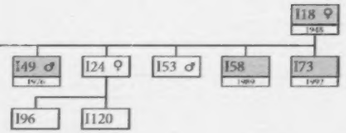


A-Clan

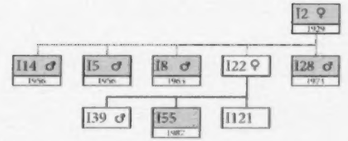
I18 Pod,
I18 Matriline
continued



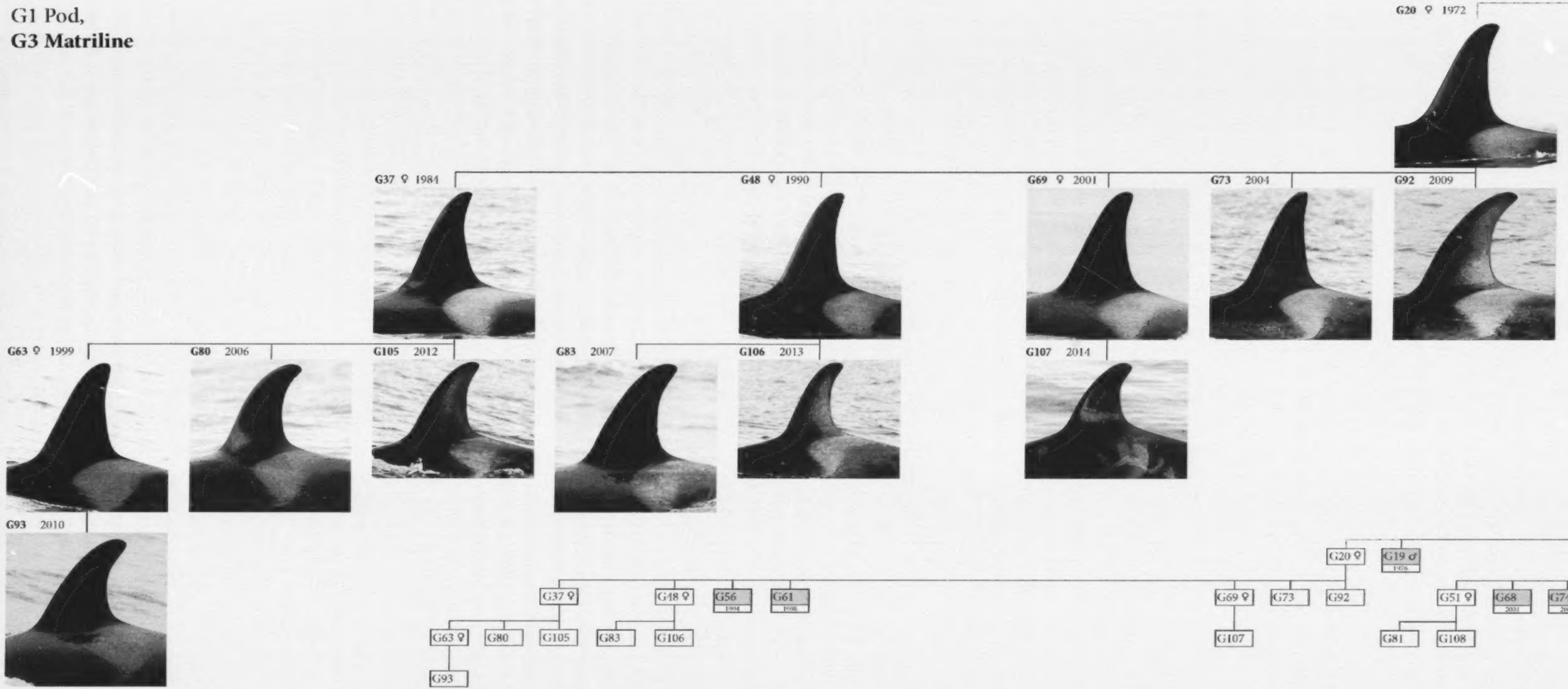
I24, her offspring, and I53 are not often found with others in the I18 matriline.



I2 Pod,
I22 Matriline



G1 Pod,
G3 Matriline



G-Clan

G1 Pod,
G3 Matriline
continued

G3 ♀ 1957

G22 ♀ 1979

G32 ♂ 1982

G51 ♀ 1992

G86 2008

G104 2012

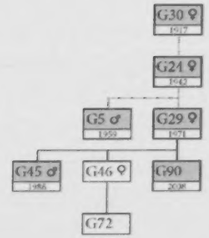
G81 2006

G108 2014

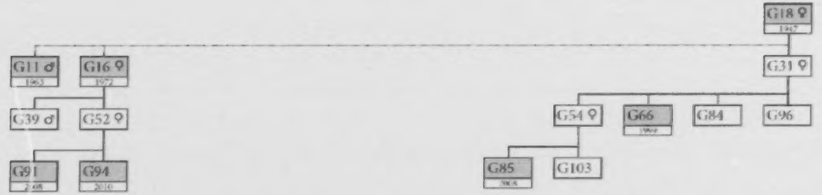
G1 Pod,
G46 Matriline

G46 ♀ 1991

G72 2005



G39 ♂ 1986
G52 ♀ 1993

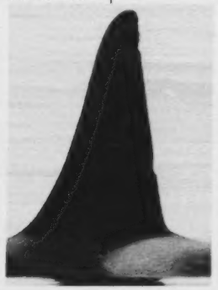

G11 ♂
1963
G16 ♀
1973
G39 ♂
G52 ♀
G91
2008
G94
2010

G31 ♀ 1981
G54 ♀ 1994
G84 2007
G96 2011
G103 2012

G18 ♀
1947
G31 ♀
G54 ♀
G66
1964
G84
G96
G85
1984
G103

G-Clan

G60 ♂ 1998



G78 2004

G65 and G38 are often found seperate from others in the G17 matriline. Similarly, G60 and G78 normally travel together independent of their other kin.

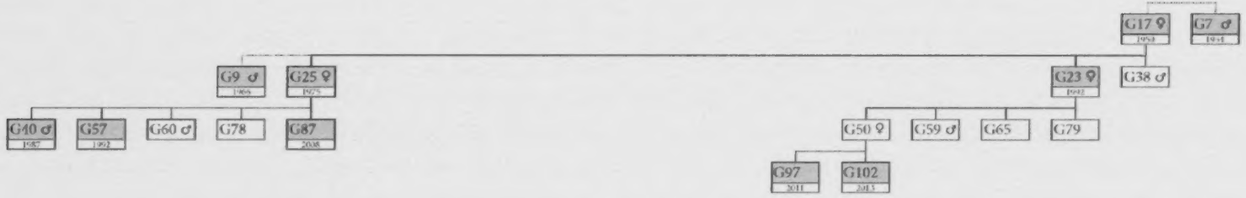
G50 ♀ 1991

G59 ♂ 1995

G65 2001

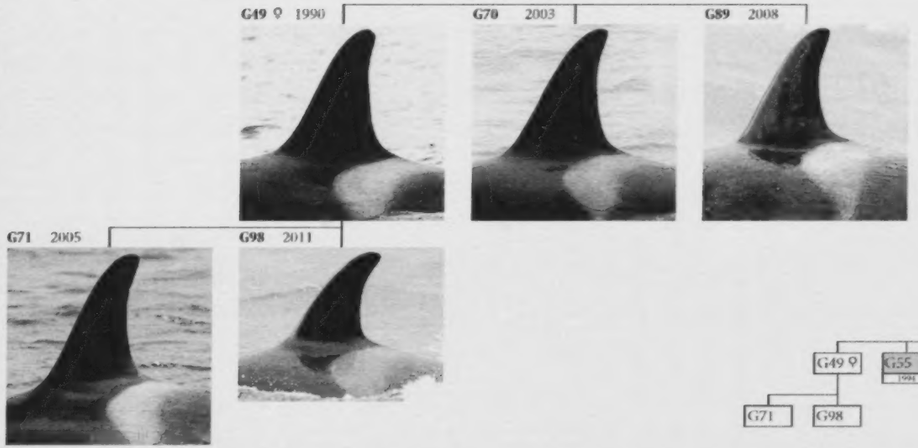
G79 2005

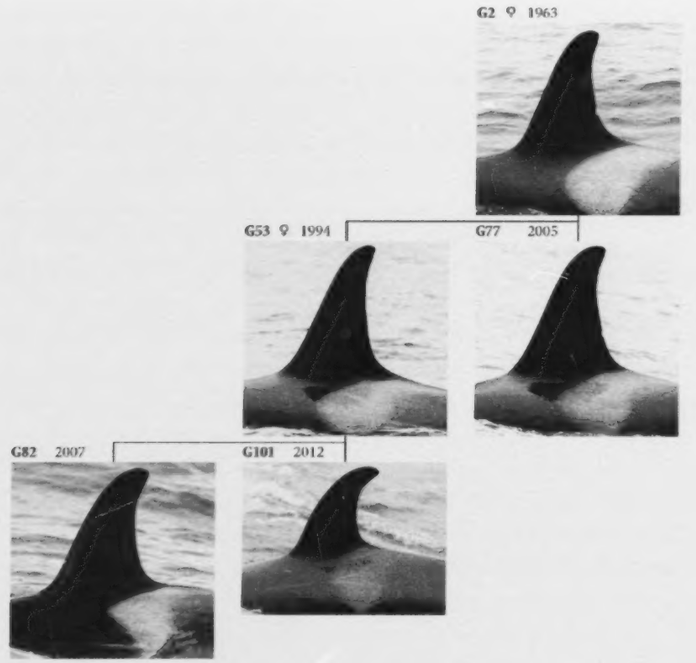
G38 ♂ 1986

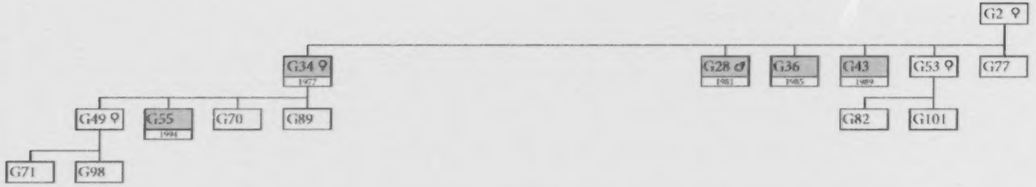


G-Clan

G12 Pod,
G2 Matriline

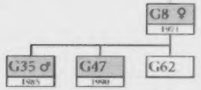






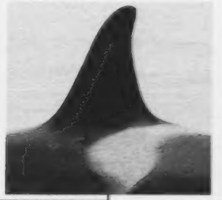
G12 Pod,
G8 Matriline

G62 1999



G12 Pod,
G27 Matriline

G27 ♀ 1974



G41 ♀ 1987

G58 ♀ 1996

G64 ♀ 2000

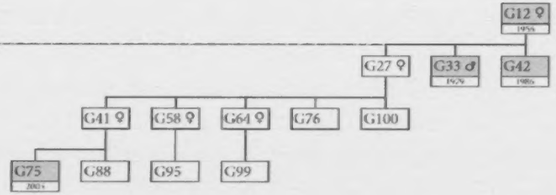
G76 2005

G100 ♂ 2012

G88 2008

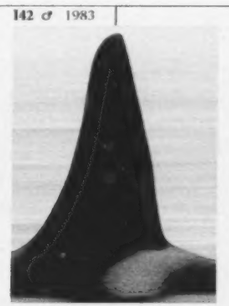
G95 2011

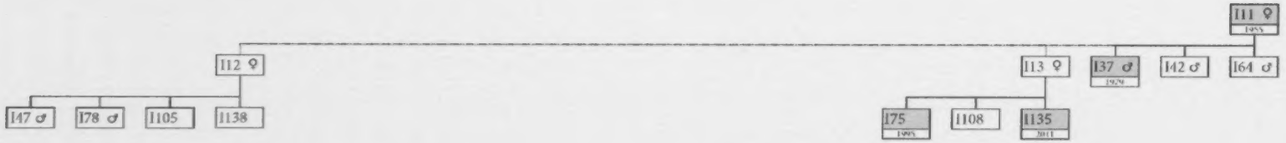
G99 2012



I11 Pod,
I11 Matriline

I12 and her offspring are often found seperate from others in the I11 matriline.





I11 Pod,
I16 Matriline

I16 ♀ 1969

I51 ♀ 1986

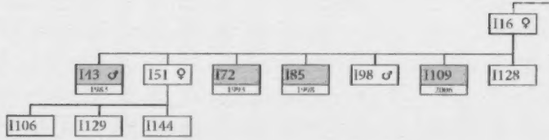
I98 ♂ 2002

I128 2009

I106 2004

I129 2009

I144 2014



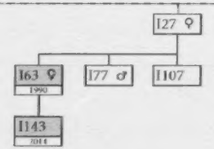
I11 Pod,
I27 Matriline

I27 ♀ 1974

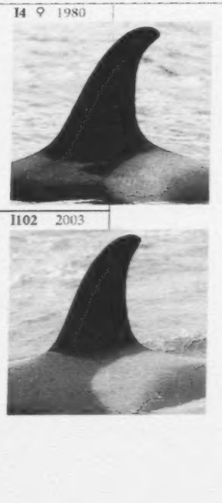
I77 ♂ 1997

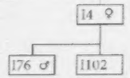
I107 2004

The four matrilines in the I15 lineage are usually found together.

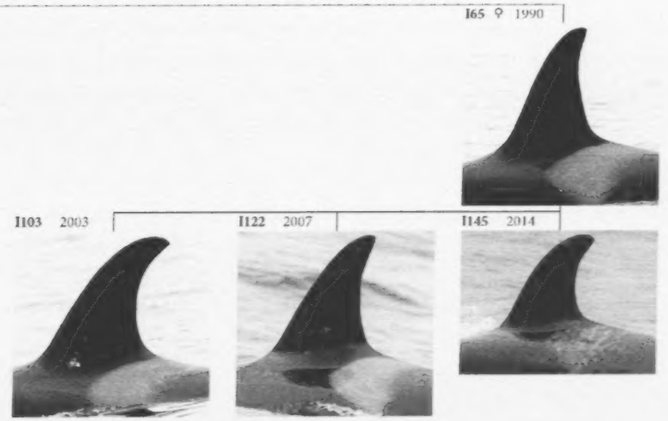


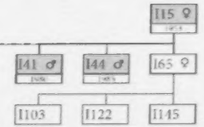
I11 Pod,
I4 Matriline



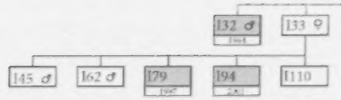


I11 Pod,
I65 Matriline

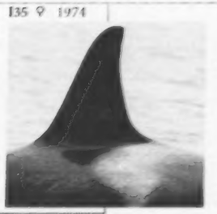


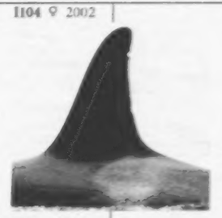


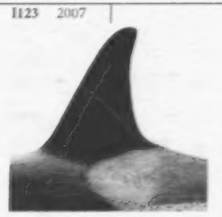
I31 Pod,
I33 Matriline

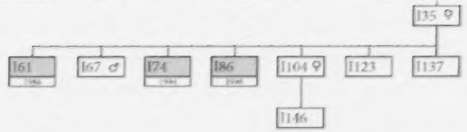


I31 Pod,
I35 Matriline

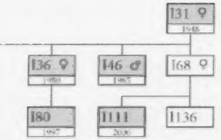




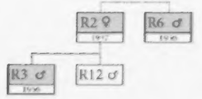


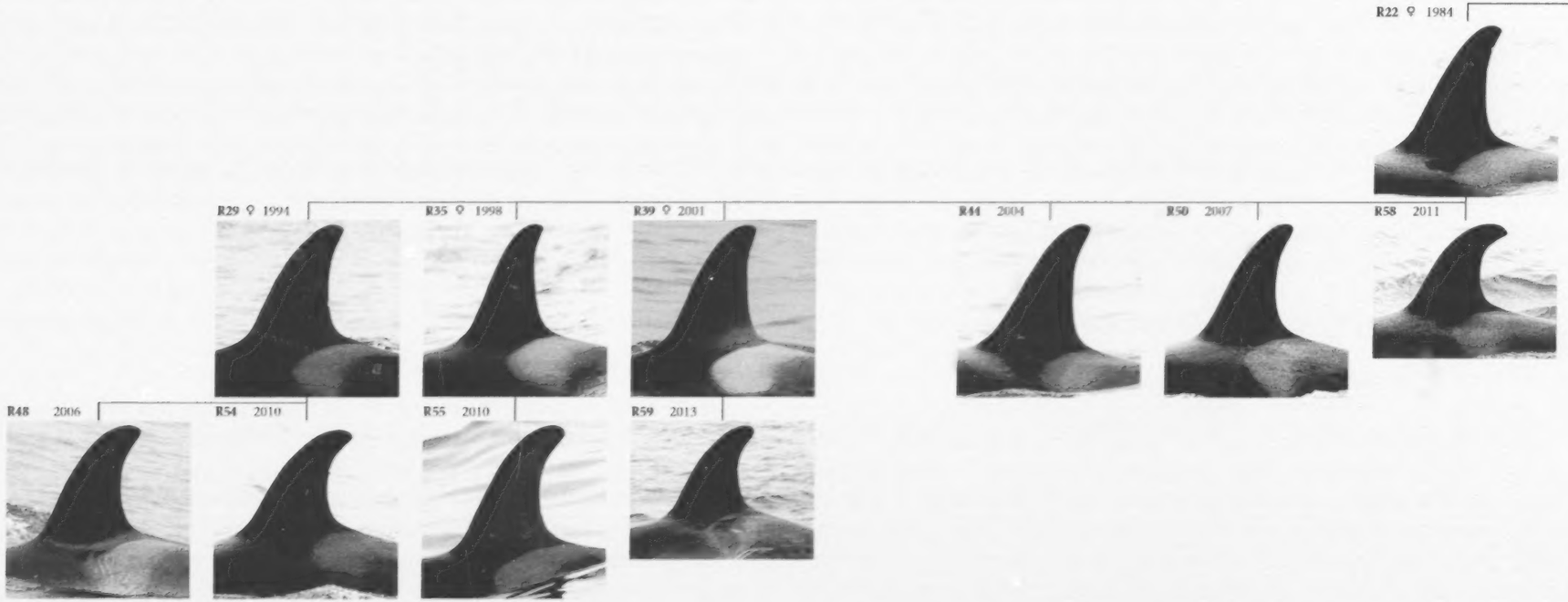


I31 Pod,
I68 Matriline



R1 Pod,
R2 Matriline

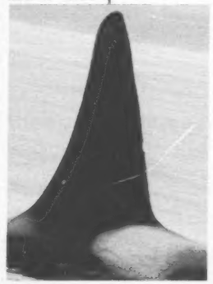


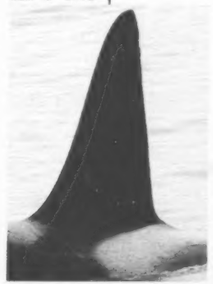


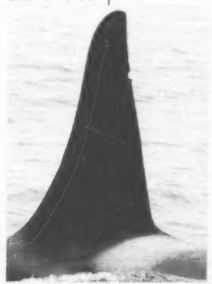
R22, her offspring, and their offspring are seldom observed in the presence of others in the R4 lineage.

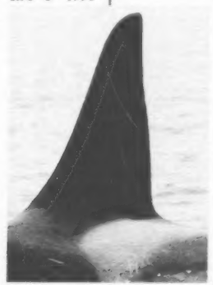
R1 Pod,
R5 Matriline
continued

R4 ♀ 1965


R26 ♂ 1988


R28 ♂ 1992


R33 ♂ 1995

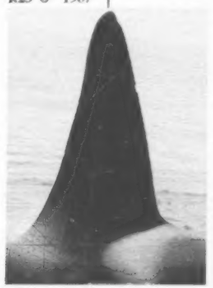

R36 ♂ 1998

R41 ♀ 2002

R61 2014

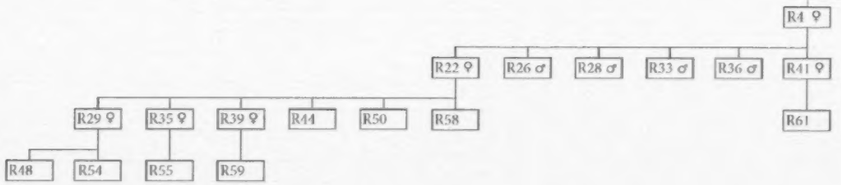
R18 ♀ 1968

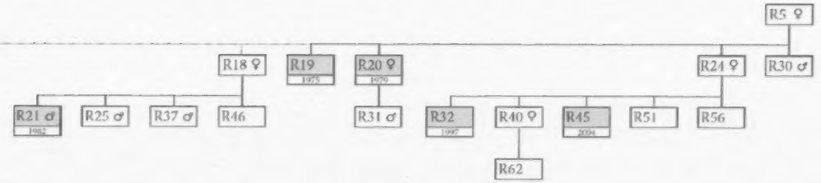
R18 and her offspring are often found travelling independent of others in the R5 matriline.


R25 ♂ 1987

R37 ♂ 1999

R46 2004





R1 Pod,
R5 Matriline
continued

R5 ♀ 1949

R24 ♀ 1987

R30 ♂ 1994

R31 ♂ 1997

R40 ♀ 2001

R51 2008

R56 2011

R62 2014

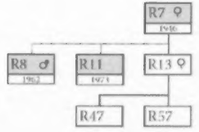
R1 Pod,
R13 Matriline

R13 ♀ 1979

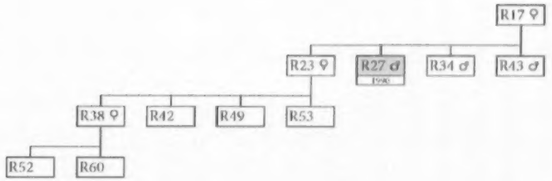
The R13 matriline is usually found travelling with W3 and R12.

R47 2005

R57 2011



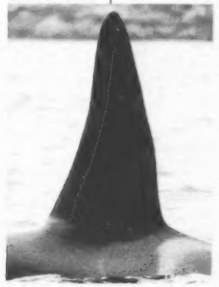
R1 Pod,
R17 Matriline



R17 ♀ 1971

R23 ♀ 1985

R34 ♂ 1996



R43 ♂ 2002

R38 ♀ 2000

R42 2002

R49 2006

R53 2009

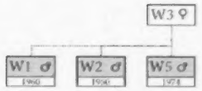
R52 2009

R60 2013

R-Clan

W1 Pod,
W3 Matriline

W3 ♀ 1935



R-Clan